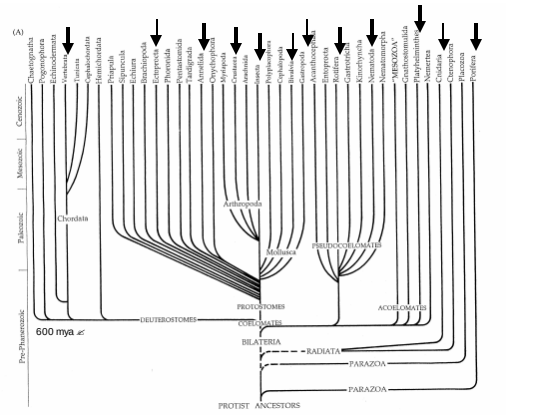


Body Plan - Body Cavities

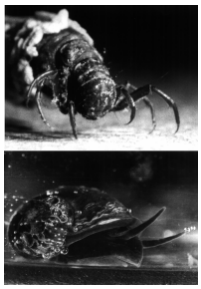
acoelomic - without coelom

pseudocoel

true coelom

Multicellular Freshwater Animals, Invertebrates

- Porifera- sponges
- Cnidaria- include hydra
- Platyhelminthes- include planarians (Turbelleria) and some important parasites
- Gastrotricha- can be abundant, benthic
- Rotifera- rotifers
- Nematoda- important predators and bactivores
- Mollusca- Gastropoda (snails and limpets) and Bivalva (clams and mussels)
- Annelida- segmented worms
- Bryozoa- sessile ciliated invertebrates
- Arthropoda- includes insects, crustacea, etc.



The Animal Kingdom

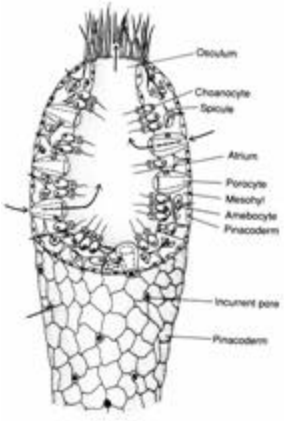
What are the factors that define an animal?

- Animals are multicellular organisms.
- Their cells lack a cell wall.
- Animals cells are organized into complex systems - organs.
- Animals are heterotrophic - they must obtain carbon and energy by eating other organisms and absorbing the consumed organisms nourishment.
- Animals require oxygen (for aerobic respiration)
- Animals can either reproduce sexually or asexually (most are sexual).
- Animal life cycles require a period of embryonic development.
- Animals are typically mobile

Body Plan

bilateral symmetry

radial symmetry

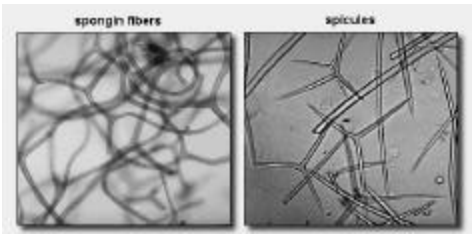


Sponge Anatomy

Porifera- sponges

- multicellular but lacks true germ layering. No true "tissue"
- outer and inner cell layers lack a basement membrane
- adults are sessile suspension feeders (larval stages are motile) - hence the importance of choanocytes to move water (and food) to and through sponge
- middle layer - mesohyl variable in structure but includes motile cells and structural elements
- skeletal elements (when present) composed of calcium carbonate, silicon dioxide and/or collagen
- most cells are totipotent - can change in form and function
  - choanocytes - flagellated cells that help circulate water throughout body of sponge - one of several specialized cell types
  - pinacocytes - surface lining cells - mainly epithelial in function - enodpinacocyte, basopinacocytes, porocytes
  - myocytes - contractile cells around canals and oscula
  - spongocytes - secrete spongin (type of collagen only in Demosponges)
  - Sclerocytes - secrete spicules

Sponges - Porifera



- Spicules are made of silica and/or calcium carbonate which provide support and protection.
- Spongin fibers also provide support and flexibility

Cnidarians

- All cnidarians have a radial body plan with tentacles.
- Almost all cnidarians are ocean animals, but a few live in fresh water.
- Species include jellyfish, hydra, sea anemones.
- Cnidarians ,are the only animals to produce nematocysts - needle like thread discharging capsules on their tentacles.

- Nematocysts play roles in capturing prey as well as fending off predators.
- Most species of cnidarians nematocyst toxin is mostly irritating to humans, however, some species of cnidarians toxin can be deadly.

Cnidarians - Body Plan

- Cnidarians have two typical body plans.
- Both are organized around a sac like gut.
- One form is the medusa, which look like tentacle fringed bells.
- Sexual reproduction stage
- All medusas float in water with their mouth centered under the bell.

- The other body from is the polyp.
- Asexual reproduction
- The polyp has a tentacle fringed mouth at one end
- while the opposite end is attached to a substrate

Cnidarians - Body Plan

- The cnidarians represent an increase in complexity when compared to the sponges in terms of gut.
- Cnidarians have a sac like gut that is permanently devoted to food processing.
- Their gut has a complex cellular lining with glandular cells that secrete digestive enzymes.
- Together, the cell types making up the gut lining, or "gastrodermis", consist of of an epithelial layer.
- Cnidarians are the simplest animals to have a organized and layered body plan.
- Cnidarians have also developed an organized " nerve net".
- The cnidarian nerve net is able to coordinate responses to stimuli.
- The nerve net interacts with sensory cells and contractile cells.
- Together, this system can control movements and shape changes.
- Some jellyfishes are able to detect changes in orientation

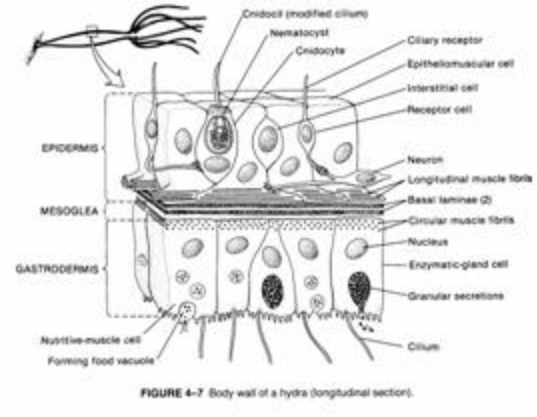


FIGURE 4–7 Body wall of a hydra (longitudinal section).

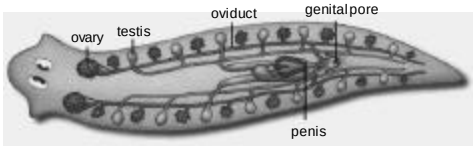
Flat Worms - Platyhelmenthes

planarian

- Flatworms include flukes and tapeworms.
- Flatworms have a sac like gut with food entering through a muscular pharynx; incomplete gut.
- Flatworms are bilateral and cephalized
- Flatworms are the simplest animals to contain organs, which are made up of different tissues.
- Flatworms also have organ systems - different organs interacting in a common task. Planarian is a tubellarian flat worm that is found in freshwater. Other tubellarians live in oceans.
- an osmoregulatory system, to maintain the composition and volume of body fluids,
- and a reproductive system
- still lack a circulatory system or gas exchange system - the surface area/volume problem still remains

Flat Worms - Platyhelmenthes

- Planarians commonly reproduce asexually by way of fission - the worm divides in half and then regenerates the missing parts.
- They can also reproduce sexually, however, they are hermaphroditic - one individual contains both sexes.
- Two flatworms will exchange sperm.

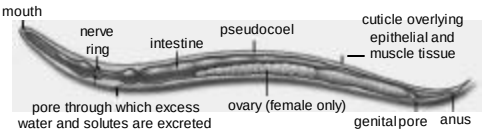


Flat Worms - Platyhelmenthes - Flukes & Tapeworms

- Other flatworms include many parasitic species such as flukes and tapeworms.
- Flukes (termatodes) tend to live in vertebrate gut, liver, lungs, bladder or blood, e.g., Schistosoma.
- Flukes have complex life cycles that may involve other specific species and sexual and asexual stages.
  - They reach maturity in a definitive host while their larval stage is encysted in an intermediate host.
- Tapeworms (cestodes) are parasites of vertebrate intestines.
- Tapeworms hook onto the intestine with a sharp scolex and reproduce asexually (budding) and sexually via hermaphroditic sperm transfer.
- Eggs are released in feces and exist in an intermediate host.

Roundworms

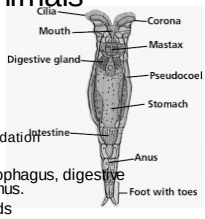
- Roundworms (nematodes) are among the simplest bilateral, cephalized animals with organ systems.
- Roundworms are successful in almost all environments and are parasitic and/or free living.
- These animals have a complete digestive system and a pseudocoel which is packed with reproductive organs.
- The pseudocoel is able to distribute nutrients and gases.
- Unique excretory system (renette cells and collecting tubes)
- Only longitudinal muscles in body wall



Gastrotricha-

- gasteros - stomach / trichos - hair
- Bilateral, unsegmented
- Effectively acoelomate
- Adhesive tubes
- Well developed cuticle often forming plates and spines
- Ciliation only on ventral surface (hence the name of the group) -cilia also covered by cuticle
- Complete gut
- Protonephridia
- Hermaphroditic or only females
- Marine and freshwater

Rotifera- wheel animals



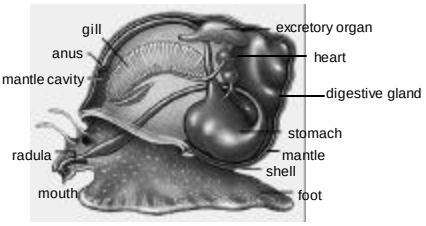
- rota - wheel / fera - to bear
- Anterior end with ciliated structures (corona)
  - Corona used in both feeding and movement
  - Feeding: suspension (with corona) but also predation
- Complete gut with regional specialization
- Rotifers have salivary glands, a pharynx, an esophagus, digestive glands, a stomach as well as an intestine and anus.
- Posterior end often with toes and adhesive glands
- Males reduced or absent (parthenogenesis)
- Marine, freshwater, semiterrestrial - sessile or free-swimming
- pedal gland at "toes" - secretions allow attachment to substrate
- Rotifers, once classified in the kingdom protista, are organized bilateral animals.
- Rotifers are less that a millimeter long and tend to live among plankton and algae.
- They also are able to maintain osmolality and may contain light sensitive cells and can change from a sessile to a free floating state.

Mollusks

- Over 50,000 different species of mollusks (soft-bodied)
- most diverse phylum in body plans
- snails, mussels, clams, oysters, octopuses, squids.....
- Mollusks share bilateral symmetry, head, foot, and visceral mass (heart, kidney and reproductive organs)
- Most reproduce sexually, hermaphrodites and unisex species
- Mollusks have a mantle - a tissue "skirt" that hangs around the body.
- Mollusks also have gills - respiratory organs are made up of thin walled leaflets across which oxygen can carbon dioxide are exchanged.
- Most mollusks have some sort of shell.
- Finally, mollusks have radula, a tongue like projection that shreds food.

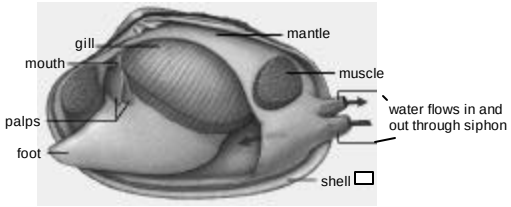
Mollusks - Gastropods

Snails and slugs are gastropods (belly-foot).



Mollusks - Bivalves

- Clams, scallops, oysters and mussels are well known bivalves (two-valved shell)
- The large foot anchors the bivalve into the ground while the gills collect food and respire.
- Food filtered into the gills find its way, via cillary action, to the adjacent palps, for sorting, and then finally to the mouth for consumption.
- Water in brought into and out of the bivalve via siphon tubes.



Annelids

- There are 15,000 different species of annelids.
- Annelid means ringed worm
- Annelids are bilateral worms with pronounced segmentation.
- Annelids have chitin reinforced bristles (setae) on each side of nearly every segment.
- The setae provide traction required for crawling and burrowing in soil as well as in swimming.
- Annelids are the simplest animals with a true coelom.
- In terms of how the earthworm benefits ecosystems,
  - they are scavengers
  - they burrow and aerate soil
  - they feed on decomposing plant material
  - they "rotate" soil - bringing rich, deep soil toward the surface

Annelids: Nervous and Vascular Systems

- Earthworms also contain a "true brain" which is able to evaluate and integrate sensory input for the entire worm.
- Leading away from the brain are paired nerve cords that extend the length of the body.
- A nerve cord is a bundle of extensions integrated with ganglion - a cluster of nerve cell bodies that control local activity.
- Earthworms, as most annelids have closed circulatory systems.
- This allows blood to flow in one direction with vessels
- It also requires some sort of pumping system.
- Annelids have regions of muscular specialization within vessels that are rudimentary hearts.

Arthropods

- the exoskeleton
  - Arthropods cuticle has become specialized into a tough, but light, flexible and protective exoskeleton.
  - The exoskeleton also inhibits evaporative water loss.
  - It does inhibit rapid growth,
    - but arthropods undergo regular cycles of molting
    - production of new, soft exoskeleton, loss of old, hardened exoskeleton, growth and hardening of new exoskeleton
- specialization of segments
- jointed appendages
- specialized respiratory structures
- efficient and developed nervous system and sensory organs
- division of labor in the life cycle

Arthropods

- Sensory organs
  - eyes
    - the insect eye is highly specialized and can receive multiple input from multiple directions at once
  - Smell
    - Antennae are sensitive chemical sensors
- **Division of Labor During Life Cycle**
  - Initially, arthropods are sexually immature larvae that molt and grow.
  - larvae typically concerned with feeding and growth
  - Larvae then enter a pupal stage, which involves massive reorganization and remodeling of tissues
  - The transformation of larvae into adult is called metamorphosis.
  - adults typically concerned with reproduction

Arthropods - Crustaceans

- Shrimps, lobsters, crabs, amphipods, copepods, cladocerans, isopods, ostracods, and crayfish are well known crustaceans.
- Most are aquatic (oceans), some are found in fresh water.
- Segment specialization include strong claws for shredding of plants and collecting organic debris as well as for defense.
- crustaceans typically have 16 - 26 different segments
- Segment specialization include sensory antennae, mandibles (jaws), maxillae (food-handling), and legs (10 pair; decapods)

Arthropoda

- Class Insecta
  - Collembola
  - Ephemeroptera - mayflies
  - Odonata- dragonflies
  - Plecoptera- stoneflies
  - Tricoptera- caddisflies
  - Megaloptera and Neuroptera - fissflies, alderflies, and spongillaflies
  - Hemiptera- true bugs
  - Lepidoptera - aquatic caterpillars
  - Coleoptera- water beetles
  - Diptera- flies and midges

Arthropods - Insects

- Insects are the most highly evolved (i.e., complex) of the arthropods.
- Along with specialization shared with other arthropods, they have sensitive antennae, paired mouth parts (chewing, biting, sucking and puncturing).
- The thorax has three pairs of legs and usually two pairs of wings.
- The gut is divided into a for-, mid and hidgut.
  - each region has specialized tasks.
- There are more than 800,000 different species of insects.
- Much more on this group later in semester

Bryozoans –
•Phylum Ectoprocta
•ecto = outside / procta = anus
•colonies of complex polymorphic zooids.
•Each individual (zooid) has mouth, organs, and anus.
•Compared to colonial cnidarians, which are simple polyps without organs
•“moss animals”

Phylum Bryozoa

• autozooids - common lophophore bearing individuals - feeding and digestion

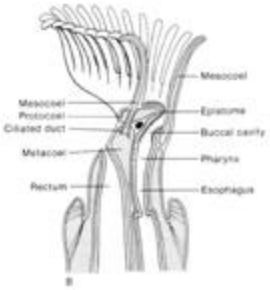
• heterozooids (can't feed)

•connections among zooids - some with metacoel continuous among individuals but most are not extensively connected. Walls b/w individuals perforate to allow movement of fluid b/w zooids

•cooperation among zooids - generating water currents - removing large particles

•lacks excretion and respiratory organs

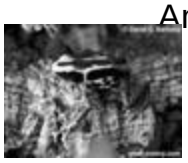
Phylum Bryozoa



Phylum Chordata, Subphylum Vertebrata

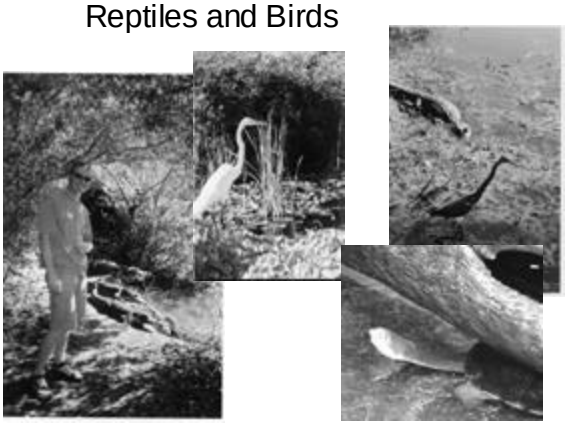
- Fishes
- Tetrapods
  - Amphibians
    - Urodela or Caudata- salamanders
    - Anura- frogs
  - Birds
  - Reptiles
  - Mammals

Amphibians



- Typically an aquatic larval stage, followed by a more terrestrial adult stage (following metamorphosis)
- Currently in decline worldwide
- Sensitive to environmental pollutants
- Gas exchange across skin

Reptiles and Birds



Mammals

- Hair
- Mammary glands
- Warm blooded